

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Sodobni koncepti v telekomunikacijskih sistemih
Course title:	Advanced Concepts in Telecommunication Systems

Študijski program in stopnja Study programme and level	Modul Module	Letnik Academic year	Semester Semester
Informacijske in komunikacijske tehnologije, 3. stopnja	Komunikacijske tehnologije	1	1
Information and Communication Technologies, 3 rd cycle	Communication Technologies	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: IKT3-646

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike	Samost. delo Individ. work	ECTS
30	30			30	210	10

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transferred to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Gorazd Kandus
Prof. dr. Tomaž Javornik
Prof. dr. Aleš Švigelj
Prof. dr. Mihael Mohorčič
Doc. dr. Andrej Hrovat

Jeziki / Languages: **Predavanja / Lectures:** slovenščina, angleščina / Slovenian, English
Vaje / Tutorial:

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Zaključen študij druge stopnje s področja informacijskih ali komunikacijskih tehnologij ali zaključen študij druge stopnje na drugih področjih z znanjem osnov s področja predmeta. Potrebna so tudi osnovna znanja matematike, računalništva in informatike.

Prerequisites:

Completed second cycle studies in information or communication technologies or completed second cycle studies in other fields with knowledge of fundamentals in the field of this course. Basic knowledge of mathematics, computer science and informatics is also requested.

Vsebina:

Novi postopki obdelave signala:
modulacijski in kodni postopki, prepletanje, raznolikost, združevanje in izenačevanje signalov, detekcija signalov, OFDM, sistemi z razpršenim spektrom, sistemi z več vhodi in več izhodi, pametne antene.

Content (Syllabus outline):

New techniques in signal processing:
modulation and coding techniques, interleaving, diversity, combining and equalization, signal detection, OFDM, spread spectrum systems, multiple input multiple output systems, smart antennas.

<p>Nove metode načrtovanja radijskih omrežij: dodeljevanje in souporaba radijskih virov, sodostop in celična načela, programska orodja za načrtovanje omrežij, modeliranje radijskega kanala, izračun pokritja z radijskim signalom, analiza prometa.</p> <p>Napredni koncepti v brezžičnih komunikacijah: radijsko dostopovno omrežje v oblaku, programirljiv radio, kooperativne komunikacije in relejne komunikacije, masivni sistemi MIMO, valovne oblike za bodoče komunikacijske sisteme, komunikacije v milimetrskem frekvenčnem področju, komunikacije na področju vidne svetlobe.</p> <p>Napredni omrežni postopki: omrežne arhitekture in arhitekture omrežnih elementov, programirljivo omrežje, virtualizacija omrežnih funkcij.</p> <p>Napredni telekomunikacijski sistemi: satelitske komunikacije, stratosferske komunikacije, mobilni komunikacijski sistemi, brezžične optične komunikacije, brezžična senzorska omrežja, omreženi vgrajeni sistemi.</p>	<p>New methods in radio network design: radio resource management and sharing, multiple access and cellular principles, software tools for communication networks design, radio channel modelling, radio signal coverage calculation, traffic analysis</p> <p>Advanced concepts in wireless communications: cloud radio access network, software defined radio, cooperative and relay communications, massive MIMO systems, waveforms for next generation of communication systems, communications in mmWave frequency bands, visible light communications.</p> <p>Advanced networking: network and network equipment architectures, software defined networking, network functions virtualization.</p> <p>Advanced telecommunication systems: satellite and terrestrial communications, high altitude platforms, wireless optical communications, wireless sensor networks, networked embedded systems.</p>
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Temeljni literatura in viri / Readings:

<p>Izbrana poglavja iz naslednjih knjig: / Selected chapters from the following books:</p> <ul style="list-style-type: none"> • T. Plevyak, V. Sahin, Next Generation Telecommunications Networks, Services, and Management, Wiley-IEEE Press, 2010, ISBN: 978-0-470-57528-4 • J. G. Proakis, M. Salehi, Fundamentals of Communication Systems, 2013, Prentice Hall, ISBN: 978-0-13-335485-0 • H. Holma, A. Toskala, LTE for UMTS: Evolution to LTE-Advanced, Wiley, 2011, ISBN: 978-0-470-66000-3 • D. Grace, M. Mohorcic, Broadband Communications via High-Altitude Platforms, Wiley, 2010, ISBN: 978-0-470-69445-9 • Z. Ghassemlooy, W. Popoola, S. Rajbhandari, Optical Wireless Communications: System and Channel Modelling with MATLAB, CRC Press; 2012, ISBN: 978-1-439-85188-3 • Jim Doherty, SDN and NFV Simplified Copyright © 2016 Pearson Education, Inc.USA, 2016, ISBN-13: 978-0-13-430640-7, ISBN-10: 0-13-430640-6
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Cilji in kompetence:

<p>Cilj predmeta je posredovati študentom obstoječa znanja iz sodobnih komunikacijskih sistemov.</p> <p>Študenti bodo seznanjeni s sodobni postopki obdelave signalov in z novimi tehnologijami, ki izboljšujejo sprejem signala ter izkoriščanje</p>

Objectives and competences:

<p>The objective of the course is to deliver to the students the existing knowledge of advanced communication systems.</p> <p>Students will be acquainted with advanced signal processing techniques and new technologies</p>

radijskih in omrežnih virov, omogočajo boljšo kakovost storitev, večjo mobilnost uporabnika, avtonomno delovanje omrežja in varen prenos informacij v omrežju.

Študenti bodo razvili sposobnost samostojnega raziskovalnega in razvojnega dela na področju naprednih komunikacijskih sistemov, ki vključuje načrtovanje, preskušanje, vrednotenje delovanja ter uvajanje sodobnih storitev v telekomunikacijska omrežja.

enabling improved signal reception, better utilization of radio and network resources, better quality of service, greater mobility of user, increased network autonomy and secure data transmission in the network.

Students will develop the ability to solve independent research and development tasks in the field of advanced communication systems, including design, testing, performance evaluation, and introducing of advanced services into telecommunication networks.

Predvideni študijski rezultati:

Študenti bodo z uspešno opravljenimi obveznostmi tega predmeta:

- pridobili znanje in razumevanje sodobnih in bodočih telekomunikacijskih sistemov
- sposobni uporabiti nove koncepte in pristope na področju telekomunikacijskih sistemov, ki vključujejo napredne metode, tehnologije, protokole, arhitekture in storitve
- sposobni raziskovalnega in razvojnega dela na področju telekomunikacijskih tehnologij
- vzpostaviti sposobnost komunikacije v angleškem jeziku na področju telekomunikacijskih tehnologij

Intended learning outcomes:

Students, successfully completing this course will:

- acquire knowledge and understanding of existing and future telecommunication systems
- gain ability to apply new concepts and approaches in the field of telecommunication systems, including advanced methods, technologies, protocols and services
- be capable for research and development work in the field of telecommunication technologies
- establish the ability to communicate in English in the field of telecommunication technologies

Metode poučevanja in učenja:

Predavanja, seminar, konzultacije, individualno delo

Learning and teaching methods:

Lectures, seminar, consultancy, individual work

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Seminarska naloga	50 %	Seminar work
Ustni zagovor seminarske naloge	50 %	Oral defense of seminar work

Reference nosilca / Lecturer's references:

- A. Hrovat, **G. Kandus**, **T. Javornik**, "A survey of radio propagation modeling for tunnels", *IEEE Communications surveys and tutorials*, vol. 16, no. 2, pp. 658-669, 2014
- **A. Švigelj**, **M. Mohorčič**, L. Franck, **G. Kandus**, "Signalling analysis for traffic class dependent routing in packet switched ISL networks", *Space communications*, vol. 22, no. 2/4, 191-203, 2013,
- T. Celcer, **G. Kandus**, **T. Javornik**, "Adaptive utility-based scheduling algorithm for multiuser MIMO uplink", *EURASIP Journal on wireless communications and networking*, vol. 2011, no. 22, pp- 1-12, 2011
- **T. Javornik**, **A. Švigelj**, A. Hrovat, **M. Mohorčič**, K. Alič. Distributed REM-assisted radio resource management in LTE-A networks. *Wireless personal communications*, Vol. 92:pp 107–126, 2017.
- **A. Švigelj**, R. Serbec, K. Alič., "Network-traffic modeling for load prediction: a user-centric approach", *IEEE Network Magazine*, Volume: 29, Issue: 4, Pages: 88 - 96, 2015